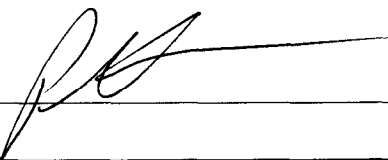


DISTRIBUTION SHEET
EO-1 LEVEL II CCB

Matt Jurotich/EO-1 Payload Manager	Pete Spidaliere/EO-1 Mission Mgr
Nick Speciale/EO-1 Mission Technologist	D.Mandl/ Ops. Mgr/GSFC
M. Perry/SYS Engineer/Swales	Chuck Zarkrzwski/Code 713
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Ken Perko/GSFC/XBPA	Steve Graham/LEISA Lead Engineer
Dennis Reuter/LEISA AC	Bryant Cramer/EO-1 Implem Mgr
Ken Anderson/ALI Instrument Mgr	Otis Brooks/EO-1
Steve Unger/EO-1 Mission Scientist	Tom Brakke/Code 932
Randy Harbaugh/Code 511	Dave Folta/Enhanced Formation Fly
John Loiacono/ALI Instrument Engr	Don Lencioni/EO-1 Instr. Scientist

NEW MILLENNIUM PROJECT CONFIGURATION CHANGE REQUEST

PROGRAM <u>EO-1</u>		TITLE B/L EO-1 TECHNOLOGY LEVEL II REQUIREMENTS DOC.	
CCR NO. <u>O R 0013</u> I N A T O R		R. CARTER/GSFC	
DATE INITIATED <u>03/09/98</u> O R I G I N A T O R ' S C H G . N O .			
DUE DATE _____		SPONSOR/CODE <u>R. CARTER</u>	PHONE <u>x8421</u>
EFFECTIVITY ITEM: <u>RGTS DOC</u> S/N _____ ITEM: _____ S/N _____ ITEM: _____ S/N _____	CHANGE CLASS	TYPE OF CHANGE	
	PRELIMINARY <input type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/>	MILESTONE <input type="checkbox"/>	INTERFACE <input type="checkbox"/>
	FORMAL <input type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/>	DOCUMENT <input type="checkbox"/>	POWER <input type="checkbox"/>
		COST ----- u	WEIGHT <input type="checkbox"/>
			OTHER <input type="checkbox"/>
DOCUMENTS OR SOFTWARE AFFECTED EO-1 Level-II Technology Segment Requirements			
PROBLEM <p>The attached draft version of Earth Orbiter-I (EO-1) Technology Level II Requirements Document requires baselining. This document contains the New Millennium Program (NMP) EO-1 Technology Level II Requirements. The Level II technology requirements specify and define requirements at the individual technology levels.</p> <p>NOTE: Significant changes with regards to WIS, GIS and FODB are currently being considered. This CCR does not address these concerns, but will be addressed at a later date when the scope is better defined. The goal here is to baseline the requirements document and add changes via the CCR process at a later date.</p>			
PROPOSED SOLUTION <p>Approve the attached draft version of EO-1 Technology Level II Requirements Document by the EO-1 Level II Configuration Control Board (CCB). Approval of this CCR will officially baseline this draft version of the Requirements document. Future changes will be initiated by submittal of Configuration Change Requests (CCRs) and Preliminary Specification Change Notices (PSCNs) for CCB approval. This document is maintained by the EO-1 Configuration Management Office (CMO).</p>			
BOARD ACTION APPROVE <input type="checkbox"/> APPROVE WITH CHANGE <input checked="" type="checkbox"/> DISAPPROVE <input type="checkbox"/> WITHDRAW <input type="checkbox"/>	APPROVAL LEVEL REQUIRED LEVEL I HQS <input type="checkbox"/> LEVEL II GSFC <input type="checkbox"/> LEVEL III <input type="checkbox"/>	CRITICALITY LEVEL EMERGENCY <input type="checkbox"/> URGENT <input checked="" type="checkbox"/> ROUTINE <input type="checkbox"/>	PROCUREMENT CHANGE ORDER CLASSIFICATION ROUTINE <input type="checkbox"/> URGENT <input type="checkbox"/> EMERGENCY <input type="checkbox"/> OPTION 1 <input type="checkbox"/> OPTION 1 <input type="checkbox"/> OPTION 2 <input type="checkbox"/> OPTION 2 <input type="checkbox"/>
COMMENTS <div style="text-align: right;"> CHAIRPERSON  DATE <u>22 Jun 98</u> </div>			

New Millennium Program/Earth Orbiter-1 Technology Level II Requirements

1.0 Introduction

This document contains the New Millennium Program (NMP)/Earth Orbiter-1 (EO-1) Technology Level II Requirements. The Level II EO-1 technology requirements specify and define requirements at the individual technology levels. These requirements address technology level functional and performance specifications that define success criteria for technology demonstrations. Also included in this document are the interface requirements to the spacecraft and ground segment.

The EO-1 mission requirement definition is accomplished in three levels. The Level I requirements define the EO-1 mission objectives and products. The Level II requirements identify and allocate appropriate requirements to mission segments (Technology, Spacecraft, Ground Segment). The Level II requirements are top level requirements for each mission segments. The Level III requirements are the lowest level requirements for the mission. The Level III requirements are directly implemented at the hardware and software levels. The Level III requirements are traced to Level II and then to Level I, respectively. All Level III requirements have either parent requirements in Level II and/or Level I, or have justification for its orphan status.

2.0 Requirement Organization

Requirements are organized and identified by Requirement ID, Requirement Type, Requirement Title, and Requirement Statement. The Requirement ID is a numbering system where each requirement is assigned a unique number. This number is used in tracing a requirement from parent to child and vice versa. The Requirement Type is an indicator for a type of requirement. The detailed description of the Requirement Type is provided in the section 3.0. The Requirement Title is a title for a requirement. The Requirement Statement provides the required action or activity. There is only one required action or activity per requirement statement.

3.0 Requirement Type Definition

H (Hierarchical) Requirement: A requirement which is not directly verifiable, but provide structure to a set of requirements. A Hierarchical requirement must be verified “through validation.” This means that the child requirements must be validated to define the success of the parent, and the child requirements must be verifiable. (Note: Child requirements may themselves be hierarchical.)

FC (Functional Category): A hierarchical requirement, which is the parent of a set of child requirements. Generally the functional category may be viewed as a container of a set of requirements which are “alike” in some manner such as;

- a. Similar Functionality
- b. Same functionality applied to different elements
- c. Are verified as a group.

F (Functional) Requirement: A functional requirement is a child requirement to a functional category. A functional requirement is the parent requirement to performance requirements. Functional requirements specify functions of the system, subsystem, instrument, or component. Functional requirements must be verifiable by test, analysis, or inspection.

P (Performance) Requirement: A performance requirement is a child requirement to a functional requirement. The performance requirements are directly verifiable, and each performance levels are verified. The performance requirements specify discrete performance levels of the system, subsystem, instrument, and/or component. The verification methods for performance requirements are test, analysis, and/or inspection.

4.0 Requirement Verification

The requirements shall be verified using methods accepted by the EO-1 Mission management. The acceptable verification methods include testing, analyses, and/or inspection. Positive verification for each requirement shall be provided. A requirement shall be verified either directly or indirectly. An example of an indirect verification would be such that Level I requirement is traced to Level II and then to Level III, where a direct verification of the Level III requirement is accomplished. In this case, the Level I and II requirements are verified indirectly and the Level III requirements are verified directly. This is an acceptable verification approach.

5.0 Requirements Verification Matrix

The requirement verification matrix shall be developed. The matrix shall identify requirement, verification method, verification acceptable criteria, verification results, and the date of verification.

6.0 EO-1 System Validation

The requirement verification matrix, along with requirements tracing to either parent or child shall be the basis for the EO-1 system validation.

NMP EO-1 Level II Technology Requirements

Requirement ID	Requirement Type	Requirement Title	Requirement Statement
01	H	NMP/EO-1 Technology: Level	This document defines Level II requirements for the New Millennium Program (NMP) EO-1 Technologies.
01.01	H	General	All technologies shall adhere to the requirements in this section as applicable.
01.01.00.01	F	Mission Life	Shall be designed to support mission life of 1 year nominally and 18 months for expendables
01.01.00.02	F	Technology Category "II"	Technologies that are in Category "II" shall have alternates ready at the time of EO-1 observatory integration and test.
01.01.00.03	F	Environment	All hardware and software shall adhere to EO-1 Environmental Requirements.
01.01.00.04	F	Mission Assurance	All hardware and software shall adhere to EO-1 Mission Assurance Requirements.
01.01.00.05	F	Verification	Shall provide for adequate visibility to accommodate effective subsystem and system functional and performance verification at all stages of development.
01.02	H	Multispectral Imaging Capability (MS/PAN)	Shall demonstrate superior multispectral imaging capability.
01.02.01	FC	Images	Shall ensure continuity of the Landsat 7 data set by collecting landsat-type MS/PAN images.
01.02.01.01	F	Image Type	Shall gather Landsat-type multispectral terrain images capturing seasonal variations encompassing one entire growing season (March thru October) in Northern Hemisphere.
01.02.01.02	F	Landsat Type Spectral Bands	Shall gather Landsat type spectral bands from 0.4 um to 2.5 um.
01.02.01.03	F	Prime Spectral Bands	Shall gather prime bands (TBS um).
01.02.01.04	F	Telescope	The telescope optomechanical performance shall provide unobstructed optics that allow substantially small focal plane diode.

NMP EO-1 Level II Technology Requirements

Requirement ID	Requirement Type	Requirement Title	Requirement Statement
01.02.01.05	F	Focal Plane	MS/PAN focal plane module shall demonstrate the mosaic of 4 Sensor Chip Assembly (SCA), each SCA having a spectrum band and pan band of 0.48 to 0.68 um.
01.02.02	FC	Calibration	Shall evaluate calibration capabilities.
01.02.02.01	F	Parameters	Shall support calibration goal of 5% radiometric for future missions.
01.02.02.02	F	Design	Shall have variable apertures, diffusers, and internal sources to support the calibration goals.
01.02.02.03	F	Calibration	Sun, moon, and deepspace shall be viewed during calibration.
01.02.03	FC	Paired Scene	Shall support 200 paired scene comparisons with Landsat 7.
01.02.03.01	F	On-orbit operation	The ALI focal plane electronics shall operate for 10 minutes maximum per daylight period of each orbit, up to four times per 24 hour period.
01.02.03.02	F	Ground Formation	Shall provide ground-based formation flying of sufficient precision.
01.02.04	FC	MS/PAN Focal Plane Thermal	Shall demonstrate non-cryogenic capability of the near and short wavelength infrared detectors.
01.02.04.01	F	HgCdTe Detectors	Demonstrate operation of HgCdTE detectors at the nominal 220 degree K thermal environment.
01.02.04.02	F	Thermal Stability	Provide the necessary thermal stability to achieve stable focal plane detector operation.
01.03	H	Wide Field, High Resolution,	Shall provide the basis for a Landsat equivalent multispectral swath width and resolution.
01.03.00.01	F	Optical Design	Optical design shall yield Landsat cross-track field with an in-track field to accommodate the detectors.
01.03.00.02	F	Optical Prescription	Optical prescription shall yield sufficient performance to support 10 m pan band.

NMP EO-1 Level II Technology Requirements

Requirement ID	Requirement Type	Requirement Title	Requirement Statement
01.03.00.03	F	Push Broom Mode	Shall operate in pushbroom mode covering entire Landsat-7 swath of 185 Km.
01.03.00.04	F	Cross Track Coverage	MS/PAN focal plane sensor chip assemblies shall permit Landsat cross-track coverage with no gaps.
01.04	H	Silicon Carbide Optics	Shall Provide the basis for reflective optical systems that are light and stable over a wide range of operating temperatures.
01.04.00.01	F	Large Aperture	Telescope shall demonstrate large aperture SiC optics.
01.05	H	Wedge Imaging Spectrometer	Shall provide the basis for the future hyperspectral imaging system.
01.05.01	FC	Images	WIS images shall be collected.
01.05.01.01	F	Focal Plane Placement	WIS and GIS shall view the same ground track.
01.05.01.02	F	Ground Sample Distance	The ground sample distance shall be same as Landsat ground sample distance.
01.05.02	FC	WIS Data	WIS data shall be evaluated.
01.05.02.01	F	Data Synthesis	Shall synthesize Landsat data, 0.4 um to 2.5 um, with the WIS data.
01.06	H	Grating Imaging Spectrometer	Shall be used to critically evaluate the time dependent spectral sampling of the WIS.
01.06.01	FC	Images	GIS images shall be collected.
01.06.01.01	F	Focal Plane Placement	GIS shall view the same ground track as WIS.
01.06.01.02	F	FPA	GIS FPA design and data format shall allow for WIS to GIS comparison.

NMP EO-1 Level II Technology Requirements

Requirement ID	Requirement Type	Requirement Title	Requirement Statement
01.07	H	Atmospheric Corrector (AC)	The Atmospheric Corrector (AC) shall enhance land imaging.
01.07.00.01	F	Image Collection	Shall collect TBD number of images to perform spectral and spatial characterization.
01.07.00.02	F	Calibration	Solar, lunar, and deepspace scans shall be used for radiometric calibration.
01.07.00.03	F	Relative Pointing	Shall be capable of determining the relative pointing of the ALI and the AC as defined in ICD.
01.07.00.04	F	Operation	AC images shall be taken while MS/PAN, WIS & GIS, and Landsat images are being collected to provide end-to-end system validation.
01.08	H	Fiber Optics Data Bus (FODB)	FODB shall serve as a data transmission media, electronics and protocol for science data between and ALI, the AC, and the WARP.
01.08.00.01	F	Data Transmission	FODB shall provide high quality science data transmission through the FODB interface.
01.08.00.01.0	P	Data Rate	FODB shall be capable of transferring at rates up to 1.0 Gbps.
01.08.00.01.0	P	Error Rate	FODB error rate shall be 1.0E-09 or less.
01.09	H	X-Band Phased Array Antenna	The XPAA shall demonstrate light weight antenna that is electronically steerable.
01.09.01	FC	Science Data Transmission and Link Error	Shall be capable of transmitting science data and link error shall be established.
01.09.01.01	F	Science Data Transmission	Shall provide a 105 Mbps QPSK data link for science data return to earth.
01.09.01.02	F	Bit Error Rate (BER)	Measurement and tabulation of basic BER shall be taken during science downlink.
01.09.01.03	F	Error Burst Length	Error burst length data shall be taken during science downlink.
01.09.02	FC	Antenna Pattern	The antenna pattern scan shall be performed periodically.

NMP EO-1 Level II Technology Requirements

Requirement ID	Requirement Type	Requirement Title	Requirement Statement
01.09.02.01	F	Antenna Gain Measurements	Main lobe antenna gain measurements shall be taken on the ground and in space.
01.09.02.02	F	Controller	Shall demonstrate the reliability of the software and controller of the array.
01.10	H	Enhanced Formation Flying (EFF)	The EFF shall provide the autonomous capability of flying over the same ground track of another S/C at a fixed separation in time.
01.10.01	FC	Autonomy	The EFF shall provide on-board autonomous relative navigation and formation flying control for the EO-1.
01.10.01.01	F	AutoCon Flight Control System	The AutoCon flight control system shall provide autonomous formation flying control.
01.10.02	FC	Ground Track	EO-1 shall fly over the same ground track (+/- 3Km) as Landsat-7.
01.10.02.01	F	Separation	Shall maintain a 1-minute in-track separation between EO-1 and Landsat-7.
01.11	H	Light Weight Solar Array (LWSA)	The LWSA shall provide the basis for future light weight solar panels.
01.11.00.01	F	Deployment	Shall demonstrate a controlled deployment using Shape Memory Alloy hinges.
01.11.00.02	F	Efficiency	Shall demonstrate specific energies greater than 100 W/Kg.
01.11.00.03	F	Dynamic Performance	Dynamic performance shall be evaluated using accelerometer during spacecraft yaw maneuver.
01.12	H	Carbon-Carbon Radiator (CCR)	The CCR validation shall provide the basis for radiators that are considerably lighter and have greater thermal conductivity than aluminum.
01.12.00.01	F	Thermal Conductivity	Thermal conductivity shall be evaluated.

NMP EO-1 Level II Technology Requirements

Requirement ID	Requirement Type	Requirement Title	Requirement Statement
01.12.00.02	F	Mechanical Properties	CCR mechanical properties shall meet the structural requirements of the S/C design.
01.12.00.03	F	Contamination	The CCR shall be encapsulated to preclude contaminating ALI.
01.12.00.04	F	Thermal Dissipation	Thermal dissipation shall be 60 W per ICD.
01.13	H	Pulsed Plasma Thruster (PPT)	The PPT validation shall provide the basis for a low mass, low cost, highly reliable, and safe propulsion system.
01.13.00.01	F	Control Capability	The PPT shall demonstrate capability to replace all science mode functions of pitch wheel.
01.13.00.02	F	Demonstration	The PPT shall be demonstrated and validated after ALI has been validated.
01.13.00.03	F	Plume	Shall confirm that the PPT plume is benign to the optical surfaces of the ALI.

Date: Tue, 10 Mar 1998 08:42:49 -0500 (Eastern Standard Time)
From: Administrator@hst-nic.hst.nasa.gov
Reply-to: (Nicholas Speciale)
Subject: CCR:0013 - DUE: 03/20/98 URGEN Level-2 Nicholas Special WWW-COMMENTS

USER : (Nicholas Speciale) sent the following comments on :

Date: 03/10/1998
CCR Number: 0013
Sponsor: R. CARTER
Due Date: 03/20/98

CCR Title: B/L EO-1 TECHNOLOGY LEVEL II REQUIREMENTS DOC.

Remote host: 128.183.212.178 Email Address:

APPROVAL STATUS: APPROVED
Note:

COMMENTS:

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Ruth, we need a couple reference documents to apply to all. (mechanical, electrical, Product Assurance, and such) Please Add These.

List The Document Name next

I'm not sure how this can realistically be verified

These belong in The GND section Requirements

John L. can provide the value

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I'm not sure what this is ~~meant~~ meant to say, please see me re: this. Actually John can rephrase it ~~for~~

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need to add
spacial and spectral
resolution and spectral
coverage, and full
185 km swath width
- see Dennis

I don't understand
the requirement.

~~miss~~
L7 takes >250
scenes per day
so we can't
actually do this

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can we do this?
Check w/ Ken Perko.

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List The ICD Name
off

CCR SPONSOR RECOMMENDATION FORM

CCR NUMBER: 0013

CCR TITLE: B/L EO-1 TECHNOLOGY LEVEL II REQUIREMENTS

CCR SPONSOR: Ruth Carter/GSFC

SUMMARY OF COMMENTS RECEIVED: (list Level 4 CCB and internal reviewers who had comments and address those comments)

Pete Spidaliere: See hard copy red lines.

Sponsor Recommendation: Incorporate all of the recommended changes to document which includes the attached red lines.

SPONSOR/ORGANIZATION: Ruth Carter/GSFC

DATE: 5/14/98